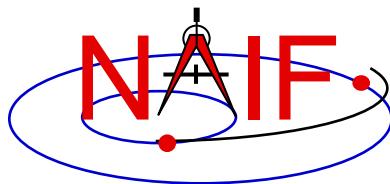


Navigation and Ancillary Information Facility

Obtaining SPICE Products Available from the NAIF and Horizons Servers

Emphasis on Kernels

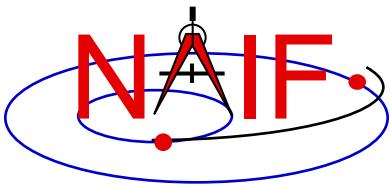
October 2022



Overview

Navigation and Ancillary Information Facility

- **Many SPICE products are available from the NAIF server**
 - These are mostly SPICE products produced at JPL
 - Access is available using the https protocol
 - See the next page for URLs
- **SPICE products made by other organizations are controlled by those organizations**
 - Some may be available from the NAIF server
 - Some may be available at other public servers, or on restricted servers, or not at all
 - » The International Planetary Data Alliance (IPDA) is working towards making large amounts of archived planetary data, including SPICE, universally available through “all” agency archives
 - Unfortunately there is no simple rule set to describe what may be found where
 - As a general rule, NAIF has no cognizance of these products



NAIF Server URLs

Navigation and Ancillary Information Facility

- **NAIF home page**

<https://naif.jpl.nasa.gov>

- Here you may access all official SPICE products produced by NAIF
 - kernels (generic, mission operations, and PDS archived ancillary data)
 - software (Toolkits and individual utility programs)
 - documents
 - tutorials
 - programming lessons
 - problem solving tips
 - rules about using SPICE
 - links to useful resources
 - access to the WebGeocalc tool
 - access to the Cosmographia visualization program

- **SPICE announcements (by NAIF)**

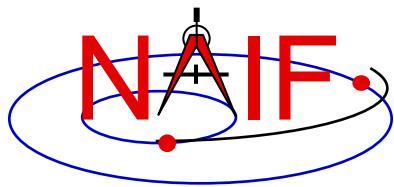
https://naif.jpl.nasa.gov/mailman/listinfo/spice_announce

For use by NAIF staff in making assorted announcements.

- **SPICE discussion (by anyone)**

https://naif.jpl.nasa.gov/mailman/listinfo/spice_discussion

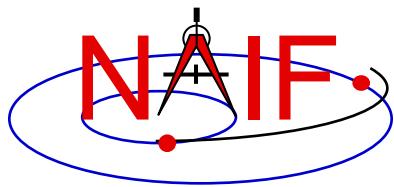
For use by SPICE users who wish to communicate with other SPICE users
(Don't use this if you have questions for NAIF staff)



Getting SPICE Kernels

Navigation and Ancillary Information Facility

- The remaining charts discuss where to find the various categories of SPICE kernel files
 - **Operational flight project kernels**
 - » For active flight projects, mostly those at JPL
 - **PDS archived kernels**
 - » Those that have been delivered to and reviewed and accepted by the NAIF Node of NASA's Planetary Data System
 - » These are the most easily used, due to the existence of `furnsh` kernels (meta-kernels)!
 - » These cover from launch to typically 6-to-9 months behind current time
 - **Generic kernels**
 - » Not tied to any one specific mission
 - » Used by many flight projects and other endeavors
 - » Some of these are also available in the other two categories
 - How to generate SPKs for comets and asteroids



Obtaining Operational Flight Project Kernels - 1

Navigation and Ancillary Information Facility

naif.jpl.nasa.gov/naif/data_operational.html

NAIF NATIONAL AERONAUTICS AND SPACE ADMINISTRATION [+ View the NASA Portal](#)

Operational Flight Project Kernels and Assorted Other Project Kernels

Kernels for currently active missions **where NAIF produces the kernels** or otherwise has access to them, kernels from some pre-SPICE era missions, and miscellaneous other mission kernels may be obtained from the NAIF server using the links below. Included under this category are some kernels from past missions that have not yet been archived in the PDS.

- [Heliophysics Missions](#)
- [Mercury Missions](#)
- [Venus Missions](#)
- [Earth Missions](#)
- [Lunar Missions](#)
- [Mars Missions](#)
- [Outer Planet Missions](#)
- [Comet and Asteroid Missions](#)
- [Astrophysics Missions](#)

Please note that kernels produced by agencies other than JPL are usually available only at those agencies, and may not be available to other than the flight project's team members. (By agreement between ESA and NASA, kernels for a few ESA-sponsored missions are mirrored at NAIF for the convenience of U.S. participating scientists.)

PDS Nodes: Atmospheres Geosciences Imaging NAIF PPI Rings Small Bodies

FIRST GOV Your First Click to the U.S. Government [+ NASA Privacy Statement, Disclaimer](#)

Open "<http://naif.jpl.nasa.gov/naif/pds.html>" in a new tab

1 - Select the mission class of interest

naif.jpl.nasa.gov/naif/data_outer.html

NAIF NATIONAL AERONAUTICS AND SPACE ADMINISTRATION [+ View the NASA Portal](#)

Data

The number of files for each SPICE kernel type is shown in the table below for the missions specified. An asterisk (*) indicates that one or more non-kernel files are also present; usually this is an 'areadme' file that explains the kernel file naming convention. The count of the number of kernels is made ONLY in the primary directory; in some cases there are additional kernels in a subdirectory (for instance, older versions of kernels that have been replaced with newer versions).

Outer Planet Missions

Mission	ck	ek	fk	ik	lsk	pck	sclk	spk
CASSINI*	5058*	473*	23*	13*	4*	352*	114*	4146*
GALILEO*	26	0		7	2	3	1	12*
JUNO*	222*			3*	11*	2*	3*	38*
NEW HORIZONS*								
PIONEER 10*								1
PIONEER 11								2*
VOYAGER 1, 2*	10		2	4	0*	2	2	9*

PDS Nodes: Atmospheres Geosciences Imaging NAIF PPI Rings Small Bodies

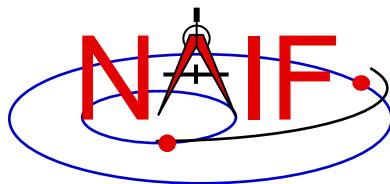
FIRST GOV Your First Click to the U.S. Government [+ NASA Privacy Statement, Disclaimer](#)

Clearance: CL#05-2438
Site Manager: Charles Acton
NASA Official: William Knopf
Webmaster: Ron Baalke
Last Updated: 10 Oct 2014

2a - Select the project name to get access to the kernels folder for that project.
(see next page)

- or -

2b - Select the kernel type to get access to all kernels of that type for that project. The number tells how many kernels of that type are available.
(see next page)



Obtaining Operational Flight Project Kernels - 2

Navigation and Ancillary Information Facility

Access to all kernels for the named project

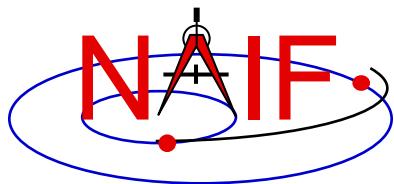
Access to kernels of the selected type for the named project

Name	Last modified	Size
Parent Directory		-
aareadme.txt	11-Mar-2004 14:39	400
ck/	06-Aug-2019 11:26	-
ek/	18-Oct-2017 19:04	-
fk/	25-Jul-2019 12:01	-
ik/	25-Jul-2019 12:06	-
lsk/	03-Aug-2016 03:12	-
pck/	22-Sep-2018 06:41	-
sclk/	16-May-2018 09:04	-
spk/	27-Sep-2018 16:55	-

Then change to the folder containing the kind of kernels of interest to you, such as SPK.

Name	Last modified	Size
Parent Directory		-
000202R SK LP0 V1P32.bsp	21-Feb-2002 13:02	238K
000202R SK LP0 V1P32.bsp.lbl	21-Feb-2002 13:02	2.3K
000202R SK V1P32 V2P12.bsp		502K
000202R SK V1P32 V2P12.bsp.lbl	3:02	2.6K
000202R SK V2P12 EP15.bsp	21-Feb-2002 13:02	198K
000202R SK V2P12 EP15.bsp.lbl	21-Feb-2002 13:02	2.5K
000203 SE JUP156.bsp	21-Feb-2002 13:03	4.9M
000203 SE JUP156.bsp.lbl	21-Feb-2002 13:03	3.2K
000331RB SK V1P32 V2P12.bsp	16-Jun-2005 13:02	623K
000331RB SK V1P32 V2P12.bsp.lbl	16-Jun-2005 13:02	5.2K
000331R SK LP0 V1P32.bsp	21-Feb-2002 13:03	307K
...		
aareadme.txt		
...		

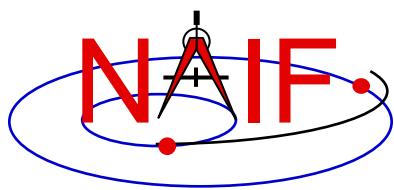
Description of file naming scheme



Obtaining PDS Archived Kernels

Navigation and Ancillary Information Facility

- **The best method for obtaining PDS archived kernels is directly from the NAIF server.**
 - Complete SPICE data sets exist on the NAIF server fully expanded—not bundled in a Zip or tar file
 - Unless you have reason to do otherwise, download the entire archival data set using the "Archive Link"
 - » That way you'll get all the latest data, the associated "furnsh kernels", and the best documentation.
 - If the data set is large and you need only a portion of it based on start/stop time, use the "subsetter" link to obtain the smaller amount of data needed.
- **Pictorial examples are shown on the next two pages.**



Obtaining Archived Kernels from the NAIF Server - 1

Navigation and Ancillary Information Facility

Mission Name	Archive Readme	Archive Link	PDS3 or PDS4	Data Size (GB)	Start Time	Stop Time	Subset Link
Cassini Orbiter	readme	link	3	17.1	1997-10-15	2014-09-30	subset
Clementine	readme	link	3	0.8	1994-01-26	1994-05-07	subset
DAWN	readme	link	3	13.5	2007-09-27	2012-09-13	subset
Deep Impact	readme	link	3	0.7	2005-01-12	2005-08-09	subset
Deep Space 1	readme	link	3	0.9	1998-10-24	2001-12-18	subset
EPOXI	readme	link	3	1.0	2005-08-23	2011-03-01	subset
GRAIL	readme	link	3	4.3	2011-09-10	2012-12-17	subset
Hayabusa	readme	link	3	0.3	2005-09-11	2005-11-19	subset

http://naif.jpl.nasa.gov/pub/naif/pds/data/co-s_j_e_v-spice-6-v1.0/cosp_1000

If you select “PDS SPICE Archives” on the NAIF web page you can do any of the following.

- You can copy and paste the "link" URL into the Unix "wget", or some equivalent tool, to download the entire data set—recommended if not too large! See the next page if data set size is an issue.

- Or you can click the "link" to display the mission's archive folder and then select specific kernels from the kernel data folders, and/or “furnsh” meta-kernels (mk) and other items from the extras folder.

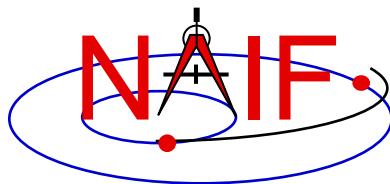
Name	Last modified	Size
Parent Directory		-
aareadme.htm	28-Mar-2013 13:15	13K
aareadme.lbl	28-Mar-2013 13:15	797
aareadme.txt	28-Mar-2013 13:15	10K
catalog/	22-Oct-2018 14:23	-
data/	30-Jun-2005 14:25	-
document/	13-Mar-2006 13:19	-
errata.txt	23-Sep-2015 11:58	11K
extras/	28-Mar-2013 13:15	-
index/	22-Oct-2018 14:24	-
software/	24-Nov-2007 09:02	-
voldesc.cat	28-Jul-2008 11:30	2.0K

[Up to higher level directory](#)

Name
ck
ek
fk
ik
lsk
pck
sclk
spk

[Up to higher level directory](#)

Name
ckxtra
extrinfo.txt
mk
orbnrm



Obtaining Archived Kernels from the NAIF Server - 2

Navigation and Ancillary Information Facility

Mission Name	Archive Readme	Archive Link	PDS3 or PDS4	Data Size (GB)	Start Time	Stop Time	Subset Link
Cassini Orbiter	readme	link	3	47.4	1997-10-15	2014-09-30	subset
Clementine	readme	link	3	0.8	1994-01-26	1994-05-07	subset
DAWN	readme	link	3	13.5	2007-09-27	2012-09-13	subset
Deep Impact	readme	link	3	0.7	2005-01-12	2005-08-09	subset
Deep Space 1	readme	link	3	0.9	1998-10-24	2001-12-18	subset
EPOXI	readme	link	3	1.0	2005-08-23	2011-03-01	subset
GRAIL	readme	link	3	4.3	2011-09-10	2012-12-17	subset
Hayabusa	readme	link	3	0.3	2005-09-11	2005-11-19	subset
Lunar Reconnaissance Orbiter	readme	link	3	201.2	2009-06-18	2015-03-15	subset

For “large” data sets that might take a long time to download, if you really need just a subset of the data covering a limited amount of time you should use the “Subset Link” for the data set of interest.

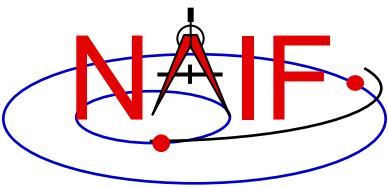
This process will automatically select just the kernels that fall within or overlap the time bounds you specify, construct a new “FURNSH” kernel(s) containing the names of this subset of kernels (thus making it easy for you to load the subset into your program), and create a custom wget script you may use to download these files to your computer.



Downloading Archived Kernels from the NAIF Server

Navigation and Ancillary Information Facility

- **Use GNU's wget or a similar utility to download the complete SPICE data set**
 - Example using wget on the Deep Impact mission:
 - » Open a terminal window
 - » wget -m -nH --cut-dirs=5 -nv (insert the URL of the "Archive Link" for the SPICE data set here). For example:
 - wget -m -nH --cut-dirs=5 -nv http://naif.jpl.nasa.gov/pub/naif/pds/data/di-c-spice-6-v1.0/isp_1000/



Obtaining Generic Kernels

Navigation and Ancillary Information Facility

 Jet Propulsion Laboratory
California Institute of Technology

[+ View the NASA Portal](#)

 The Navigation and
Ancillary Information Facility

[Home](#)
[Announcements](#)
[About SPICE](#)
[About NAIF](#)
[For Projects](#)
[For the Public](#)
[Data](#) (circled)
[Utilities](#)

SPICE Data (SPICE Kernels)

- [PDS Archived SPICE Data Sets](#)
- [Operational Flight Projects Kernels and Other Non-archived Project Kernels](#)
- [Generic Kernels](#) (circled)

As shown above, three categories of SPICE data, often referred to as kernels, are available from this website. You should carefully read about all three of these categories using the links below in order to find the best data for your needs.



 Jet Propulsion Laboratory
California Institute of Technology

[+ View the NASA Portal](#)

 The Navigation and
Ancillary Information Facility

[Home](#)
[Announcements](#)
[About SPICE](#)
[About NAIF](#)
[For Projects](#)
[For the Public](#)
[Data](#) (circled)

Generic Kernels

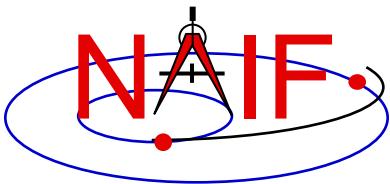
[Generic Kernels](#) (circled)

SPICE kernels that exist independent of any particular flight project are called generic kernels. These may be obtained from the Generic Kernels link of the NAIF server appearing above.



Generic kernels are just a few clicks away...

Name	Last modified	Size
 Parent Directory		-
 AACLEARANCE STATEMENT.pdf	28-Sep-2017 16:47	49K
 aareadme.txt	07-Nov-2018 11:32	3.6K
 dsk/	08-Jul-2017 04:03	-
 fk/	02-Apr-2007 17:57	-
 lsk/	29-May-2018 16:36	-
 pck/	31-Oct-2019 17:07	-
 spk/	29-Aug-2013 14:25	-
 stars/	15-Feb-2007 17:36	-



Horizons

Navigation and Ancillary Information Facility

- **The Horizons server is an on-line ephemeris generator for natural bodies (and more)**
 - It is operated by JPL's Solar System Dynamics Group, not by NAIF
- **Of primary interest to SPICE users is its ability to generate up-to-date SPK files for comets and asteroids**
 - Horizons home page:
 - » <https://ssd.jpl.nasa.gov/horizons/>
 - Horizons web interface for manual generation of small body SPKs:
 - » <https://ssd.jpl.nasa.gov/horizons/app.html#/>
 - Horizons telnet interface for automated (programmatic) generation of small body SPKs:
 - » **telnet ssd.jpl.nasa.gov 6775**
 - » **For an example script, use anonymous ftp to go to:**
 - **ssd.jpl.nasa.gov**
 - » **and once there, look at:**
 - **pub/ssd/SCRIPTS/smb_spk**